BRIEFER ARTICLES.

RECENT WORK UPON THE DEVELOPMENT OF THE ARCHEGONIUM.[1]

In a recent paper already reviewed in the Gazette,[2] M. L. A. Gayet has presented the results of an extended series of observations upon the development of the archegonium in the Muscineæ. These studies were pursued in part under the direction of Professors Van Tieghem and Flahault, and include the principal groups of Hepaticæ and Musci.

Having covered much the same ground in a work published nearly three years ago,[3] I have followed with much interest the results of M. Gayet's investigations. Inasmuch as these differ a good deal from my own observations in certain details of the development of the archegonium in both liverworts and mosses, I have examined again a considerable number of my preparations to see how far these would confirm the results obtained by Gayet.

Of the genera studied by Gayet, my own work included Riccia, Sphærocarpus, Targionia, Madotheca, and Anthoceros, all of which were examined in detail. On the other genera, Pellia, Marchantia, Preissia and Lophocolea, my own observations were either very incomplete or entirely lacking, but a number of other genera were included.

It has been generally supposed that the Hepaticæ differ radically from the Musci in the fact that the growth of the archegonium in the latter is mainly apical, while in the liverworts the growth in length is for the most part intercalary, the "cover-cells" of the archegonium being very early divided by intersecting quadrant walls. Gayet claims, in the first place, that he has demonstrated that this division does not take place until a late period, and that repeated segments are cut off from the cover-cell which add to the length of the neck; that is, in the

[1] Gayet, L. A.: Recherches sur le développement de l'archegone chez les Muscinées. Annales des Science Naturelles Bot. VIII. 3: 161–258. 1897.

[2] January 1898.

[3] Structure and development of the mosses and ferns: Macmillan, London. 1895.

Hepaticæ, as in the true mosses, the growth in length of the archegonium neck is in part apical. On the other hand, he maintains that, contrary to the generally accepted view, the moss archegonium does not have the canal cells of the neck cut off from the base of the apical cell, but they are the result of the division of a primary neck-canal cell as in the Hepaticæ. In short, he recognizes no essential difference in the type of archegonium in the two classes of bryophytes.

The first genus treated by Gayet is Riccia, of which he studied several species, including *R. glauca*. He does not, however, make it clear in his figures from which species the drawings were made. I have drawn from one of my slides of *R. glauca* a longitudinal section of the young archegonium which is shown in the accompanying *fig. 1*. It is perfectly evident that here the cover-cell has already undergone the quadrant divisions and no longer can function as an apical cell. The archegonium here figured is about the same age as the one figured by Gayet in *fig. 7* of his first plate. The occurrence of two resting nuclei in the terminal cell, without any trace of a division wall, shown by him in *fig. 5* of the same plate, is, to say the least, remarkable. It is extremely likely, however, that proper staining would have shown a vertical wall between them.

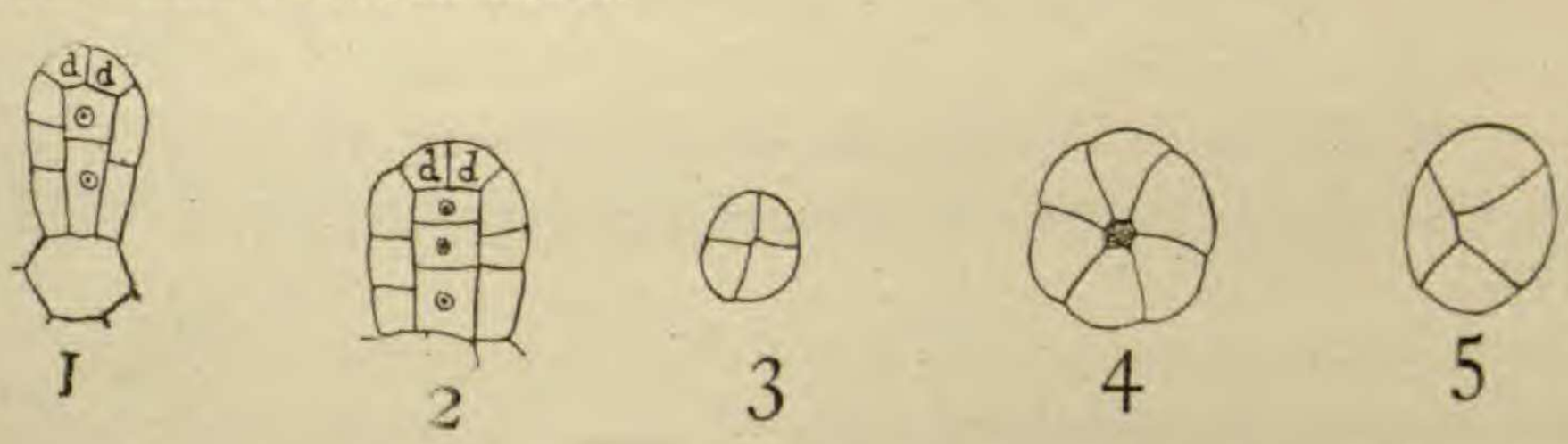

Fig. 1. Median longitudial section of the young archegonium of *Riccia glauca; d, d*, the cover-cells.— Fig. 2. A similar section of the archegonium of *Targionia hypophylla*.—Fig. 3. Transverse section of the four cover-cells of the young archegonium of Targonia.— Fig. 4. Cross-section of the neck of the archegonium of *Sphærocarpus terrestris*, var. *Californicus*, showing the six peripheral cells.— Fig. 5. The four cover-cells from a young archegonium of *Porella* (*Madotheca*) *Bolanderi*.—All the figures drawn with the camera from microtome sections.

The accompanying figures of the young archegonium of Targionia, *2, 3*, show that here too, the quadrant divisions of the terminal cell occur very early, and that any appreciable growth in length of the neck due to the activity of an apical cell is out of the question.

Of all the forms examined by me, the one which approached nearest the condition described by Gayet was *Porella* (*Madotheca*) *Bolanderi*.

While in this species there is an early quadrant division of the cover-cell (see *fig. 5*), the four resulting cover-cells are larger than is usually the case, and there may apparently be a limited number of the outer neck-cells which are cut off from these cells. Such a case is shown in *fig. 46, E*, of my *Mosses and Ferns*. That the cover-cells of the liverwort archegonium may undergo one or two divisions subsequent to the original quadrant-divisions, has been long known, but I have been unable to convince myself that any apical growth, in the sense in which it is understood among the true mosses, can be demonstrated in any of the liverworts examined by me.

Six rows of peripheral neck-cells are regularly found in the archegonium of the Marchantiaceæ while the normal number is five in the Jungermanniaceæ. I have found that in *Sphaerocarpus terrestris* var. *Californicus* and the allied Geothallus, there are six rows of peripheral neck-cells, in which respect, as well as others they are intermediate between the Ricciaceæ and thallose Jungermanniaceæ. Gayet disputes the accuracy of my statement in regard to Sphærocarpus, and it is possible that the European form of the species may show but five rows of cells. Neither of the two figures of Sphærocarpus shown by Gayet is a cross-section, nor does he say whether he actually examined such sections. In the few cross-sections of the archegonium neck which I have made, the number of cells was six (see *fig. 4*), although it is possible that this number may not always be constant.

It is to be regretted that M. Gayet has not given a more detailed account, as well as additional figures, of the archegonium of the thallose Jungermanniaceæ. He finds that in Pellia, as well as other Anacrogynæ, there may be six rows of peripheral cells, instead of the usual five rows hitherto supposed to be constant in this group, aside from Sphærocarpus and Geothallus. It is not strange that these primitive forms should show this approach in their structure to the Ricciaceæ with which they are closely connected by Sphærocarpus. It is to be hoped that we may soon have further information on this interesting point.

In regard to the statement that in the Musci the neck canal-cells are not cut off from the base of the terminal cell, as has been hitherto supposed, it cannot be said that Gayet's figures are very convincing. This very difficult point can only be settled by means of very thin axial sections of young archegonia. Here, too, a proper staining of

of the division walls, such as M. Gayet seems to have considered superfluous, is very essential.

In studying M. Gayet's technique it is evident that he has depended too much upon rather primitive methods. While he has had recourse to various fixing and staining agents, he admits that so far as possible he has depended upon free-hand sections or "dissociation," *i. e.*, the dissection with needles of material treated with a strong macerating fluid. Where objects were too small to be thus handled they were imbedded in celloidin, which was then included in a coating of glycerine-soap. He does not appear to have employed paraffin for imbedding, nor to have employed any but nuclear stains, and it is very evident from some of his figures, *e. g.*, *5*, *83*, that cell-walls were in some instances entirely overlooked. In my own studies of the archegonium I have found such thin serial sections as can most readily be made by the paraffin method indispensable, and some good stain for the cell-walls, like Bismarck-brown, is necessary in order to differentiate the young cell-walls. The doubtfulness of conclusions drawn from a study of optical sections alone, from material rendered transparent by potash or other clearing agents, need not be insisted on here.

In short, until some of the statements made by M. Gayet can be confirmed by a thorough study of properly stained serial microtome sections, his conclusions can hardly be accepted without a certain amount of reservation.— Douglas Houghton Campbell, *Leland Stanford Junior University.*

THE HOMOLOGY OF THE BLEPHAROPLAST.

The recent investigations upon plant spermatozoids have not only added immensely to our knowledge of the structure and development of these organisms, but have brought out interesting suggestions as to the homologies of certain structures.

Previous to 1894, writers were concerned largely in discussing whether the body of the spermatozoid consisted of nucleus alone, or of both nucleus and cytoplasm. All agreed that the cilia are developed from the plasma. Later contributors, Belajeff, Hirasé, Ikeno, Webber, Shaw and Fujii, have shown conclusively that the body of the mature spermatozoid consists of both nucleus and cytoplasm; and, further,